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THE MAKING OF RATES FOR WORKMEN'S COMPENSATION INSURANCE

Perhaps no phase of workmen's compensation insurance is more interesting, or less familiar, to the layman than the principles and practice of rate-making. If the interested layman be an employer, he has been assured that the rate for his establishment is derived from actual experience, perhaps even that the present rates are the most scientific ever devised by the wit of man;[1] if an academic inquirer, he has learned of pure premiums, loadings, and multipliers, and of various formulae for the calculation of each; but in neither case has he been able to obtain much information as to the actual processes of rate-making.[2] It is hoped, therefore, that a non-technical analysis of these processes may be of value to that growing body of economic students who concern themselves with social insurance.

All insurance rates are made up of two factors: the "pure premium," or actual benefits insured, and the "expense loading,"

[1] Cf. press notice of the National Workmen's Compensation Service Bureau in the *New York Journal of Commerce*, March 9, 1917.

[2] See Scattergood, "The Calculation of Workmen's Compensation Premium Rates," in *Annals of the American Academy*, March, 1917, p. 255; *Synthesis of Rates, for Workmen's Compensation*, Fidelity and Casualty Co., 92 Liberty St., New York.

or cost of insurance management.[1] These primary factors are so far independent that a separate discussion of them will conduce to clearness. Both, again, are markedly affected by the type of insurance organization; for neither the expenses of management nor the initial pure premium need be the same in the case of an insurance monopoly as in the case of competing insurers.[2] In this country, however, the principles of competitive rate-making have usually been applied (at least ostensibly) even by state monopolies. At the same time the great bulk of the business (probably not less than four-fifths of the total)[3] is carried by competing insurers. The present paper, accordingly, will deal exclusively with competitive rate-making, which is at once the more complex problem and the subject of greater immediate public interest.

I. PURE PREMIUMS[4]

Two features sharply distinguish competitive from monopolistic insurance rate-making: the rates must be "prospective," and they must cover the full ultimate cost of the benefits insured against. Both features derive from the purely contractual relationship of insurer and insured. A competing insurance carrier has no hold upon its clients beyond the term of the insurance contract (in this case usually one year);[5] no guaranty of their continuance except its ability to win their patronage, and hence no power to collect from

[1] Expense loading does not appear as a part of the rate in the case of those state-conducted insurers whose expenses are paid out of public revenues. Such insurers have two sources of income, premiums and appropriations from the public treasury. But in the case of these insurers the premium rates do not represent the full cost of insurance.

[2] See "The Organization of Workmen's Compensation Insurance," the *Journal of Political Economy*, XXIV, 951.

[3] See totals for 1915 cited by H. E. Ryan, *Annals of the American Academy*, March, 1917, p. 245. The totals for 1916 are certainly greater by several millions, but the proportions are probably not much different.

[4] In this country both the pure premium (or net benefit cost) rate and the total premium rates are invariably expressed in cents per $100 of employers' pay-roll. Thus an accident cost of $6,000 on an insured pay-roll of $1,000,000 would produce a "pure premium" of $0.60. This, with the average expense loading of 40 per cent of total premium, would give a premium rate of $1.00.

[5] Even the annual term is not fixed; either party may cancel the contract at any time upon giving the stipulated notice.

present policyholders the means of discharging obligations which arose under past contracts. To be secure of continued solvency, such a carrier must operate on the "full reserve" plan; that is to say, its premiums must cover, not only the payments to be made within the insurance period, but, as well, the reserves necessary for the final discharge of all claims which arise during the policy term.[1] An insurer, moreover, who relies upon purely voluntary contracts is competitively obliged to sell insurance at a stipulated maximum rate, fixed at the beginning of the policy period. For the employer buys insurance to escape risk and he is so intent upon this point that any uncertainty in the final maximum rate is a competitive disadvantage.[2]

The pure premiums of competitive insurers, accordingly, are not the actual payments made, or even the actual costs incurred, during an insurance year,[3] but the *expected* cost to be incurred

[1] Cf. *Annals of the American Academy*, March, 1917, p. 297.

[2] A fixed maximum rate of premium and an absolute guaranty against losses not covered by the premium are often said to characterize joint-stock, in contradistinction from mutual, insurers (cf. Rubinow, *Social Insurance*, p. 143). But this distinction is rather *de jure* than *de facto*. Legally, a mutual has the right to levy assessments beyond the stipulated premium rate; practically an assessment would be fatal to survival. The successful mutuals in this country all charge, in effect, a fixed maximum rate. Some of the best-managed mutuals maintain as well a level rate of policy "dividends." The net rates of the American Mutual or the Massachusetts Employees' Insurance Association, for example, are as definite and as well understood by policyholders as the net rates of stock companies. In most of the states, moreover, insurance does not relieve the employer of his liability to pay compensation, so that the "absolute guaranty" above spoken of extends no further than the solvency of his insurer, whether stock or mutual.

[3] The insurance year is not, as a rule, the calendar year, but the policy year. Policies usually are issued for terms of one year, or, if for a longer term, are divided into years of account. Thus a policy issued January 1, 1916, will terminate January 1, 1917, and a policy issued December 31, 1916, will terminate December 31, 1917. All premiums, losses, and specifically allocated expenses arising from policies issued in 1916 are referred to the policy year of issue, 1916, so that the policy year, or year of account, 1916, extends, chronologically, from January 1, 1916, to December 31, 1917, and overlaps, in point of time, the years of issue 1915 and 1917. This practice arises from the desire of insurers to distribute their business evenly throughout the year. As a matter of accounting it occasions no confusion and is, indeed, the only feasible method, given business so distributed, of referring losses and expenses to premiums and pay-roll exposure. It results, however, in throwing experience back one year so that in a rate revision in the early part of 1917 the latest available experience is derived from the year of issue 1914.

within the period covered by the insurance contract. This expected cost is perforce estimated in advance of the insurance period and on the basis of past experience. Two elements of uncertainty are thereby at once introduced into the calculation. (1) The past, even the recent past, never exactly prognosticates the future. Not only are industrial equipment, methods, and personnel forever changing, with consequent changes in the number and severity of work accidents; accident rates apparently are affected also by economic cycles of depression and prosperity.[1] In many, if not most, industries changes in technique and personnel are so rapid that accident experience may be said to become obsolescent in five years' time, while cycles of business activity are so unpredictable that the experience of a series of favorable years may come to be applied to a year of abnormal risk,[2] and vice versa. (2) For the reasons just stated it is only the experience of the recent past which can safely be relied on for rate-making, and the experience of the recent past always contains a large element of more or less uncertain future payments.

To make this last point clear, a rough analysis of compensation benefits will suffice. *Death benefits* commonly take the form of weekly or monthly payment to dependents, either for a stated period or for the duration of presumed dependency. In the latter case, if the payments continue on the average no more than ten years[3] and fatalities are evenly distributed throughout the year, only one-twentieth of the total death benefits incurred in any insurance year will have been paid at the end of the year. *Permanent disability benefits*, in this country, usually are weekly payments for a limited period; if payable for life, about one-fortieth of the whole incurred amount will have been discharged within the

[1] See Mowbray and Black, "On the Relation of Industrial Accidents to Business Activity," *Proceedings of the Casualty Actuarial and Statistical Society of America*, II, 418.

[2] This is precisely what occurred with respect to compensation insurance rates projected in the fall of 1915 upon experience developed by policies issued in 1912 and 1913.

[3] After allowing for mortality and remarriage of dependents and for the age at which legal child-dependency ceases.

insurance year.[1] *Temporary disability benefits*, in the nature of the case, run for shorter periods; the greater part will have been discharged within the insurance year of incurrence. *Medical, hospital, and funeral benefits* stand in similar case: the bulk of these services are furnished and paid for within a few weeks after the occurrence of the accidents which occasion them. The proportion of incurred benefits which are still outstanding at the end of an insurance year, therefore, will vary pretty directly with the form and amount of compensation for death and permanent disability. Under what might be styled a full indemnity law, which provides pensions throughout the period of disability or dependence, future payments would comprise some 80 per cent of the incurred cost of a single year and more than half of the cumulative pure premiums for a five-year period. Under a limited benefit law, such as that of Pennsylvania, this proportion would fall to about 60 and 25 per cent, respectively.

The large proportion of "outstandings" to total incurred cost would not seriously complicate the determination of pure premiums if the outstandings themselves could be accurately ascertained. Unhappily this is not the case. The cost of recent claims is uncertain because many cases of apparent temporary disability will develop into death or permanent disability. Even with respect to known fatal and permanent cases valuation is no easy matter. The present value of future payments for these cases is affected by both mortality and remarriage, neither of which factors can be satisfactorily measured from existing data. The American Experience Table, for example, is a table of selected lives, whereas industrial accident pensioners are representative of the general population. Death benefits, moreover, are joint, rather than several annuities. Thus the New York Act awards 30 per cent of wages to a widow alone, 40 per cent to a widow and one child, $66\frac{2}{3}$ per cent to a widow and five or more children, the pension in respect of each child ceasing at the age of eighteen. The valuation

[1] This assumes an average life-expectancy of twenty years (probably too low) and disregards interest. This true proportion is perhaps nearer 1:36. This proportion will not, of course, hold of minor permanent injuries, such as loss of fingers.

of such a pension evidently involves the principle of group survivorship. In the absence of appropriate American data the administrative authorities of New York have fallen back upon the Danish Survivorship Annuitants' Table, which gives even higher values than the American Experience Table, because of the exceptional longevity of the Danish population. As to persons permanently disabled by accident it is still a moot point with actuaries whether their longevity is greater or less than that of the general population. If mortality among compensation pensioners is thus uncertain, the remarriage rate is, as yet, wholly conjectural. The New York authorities, again, have relied on the experience of the Dutch Royal Institute[1] as a *pis aller;* but that the remarriage rate of Italian and Slavic widows in the United States will coincide with that of Hollanders in their native land is neither proved nor probable.[2] To make a bad matter worse, outstandings are at present estimated by some fifty insurance carriers, each acting independently and upon no uniform principle.

Thus far it has appeared that compensation insurance rates are projected into the future upon the basis of past pure premiums which, in the nature of the case, will never be exactly reproduced by the future period to which these projected rates apply and which cannot be accurately determined even for the past period from which the pure premiums are derived. The errors arising from both these sources are immensely aggravated by the subdivision of experience into industry classes. Rightly or wrongly, it has come to be assumed on every hand that compensation insurance rates should be adjusted as far as possible to the specific accident cost of each definable industry. Since, however, the unit of compensation insurance is necessarily the entrepreneurial establishment, the attempt to classify industries by degree of accident hazard has resulted in a classification of business enterprises in terms of work performed or product turned out. Some 1,500 risk classes

[1] See Fondiller in *Proceedings of the Casualty Actuarial and Statistical Society of America*, Nos. 4 and 6.

[2] The estimated value for each $100 annual compensation to a widow is $941.046 at age 20, $1,151.593 at age 25, $1,600.95 at age 43 (maximum), and $1,197.493 at age 60; decreasing probability of remarriage more than offsetting mortality up to age 43. The validity of these relative values appears at least dubious.

have in this way grown up, for each of which a pure premium is to be established ostensibly on the basis of its own experience. Even this is not all. American compensation acts are state, not national, in scope. Both the legal benefits and the spirit in which the laws are administered differ widely from state to state, and even from time to time within the same state, so that experience had under one jurisdiction or under one benefit scale cannot directly be applied to any other. The 1,500 risk classes must accordingly be further split up into thirty or more state units. The ultimate subdivision in most instances, obviously, is too small to afford any dependable indication of accident cost. On the one hand, any particular industry is much more liable to violent fluctuations, whether from technological progress or from economic cycles, than is the whole mass of business enterprise; on the other hand, the smaller the numbers dealt with, the greater the probability of chance deviation. If a given industry or group of industries produces 100,000 accidents annually, the probabilities are strong that the series will be reasonably stable; in particular neither the proportion of deaths, of permanent disabilities, and of long-term temporary disabilities, nor the total number of such injuries per unit of exposure will vary widely from year to year unless in consequence of profound technological or economic disturbance. But when the number of insured workmen in the risk group falls to a few hundreds[1] neither the accident rate nor the accident cost per $100 of pay-roll is a proper basis for prediction.

Various attempts have been made to overcome the deficiency of exposure in the ultimate risk classes by grouping related classifications and by combining the experience of different states in the same classifications. Both methods enlarge the exposure at a more or less serious cost of homogeneity and thereby of dependability. The principles of combination in the two cases are so dissimilar that a separate discussion of each is necessary.

[1] In the state of Wisconsin only 188 risk classes developed as much as $100,000 insured pay-roll in two years' experience (see *Bulletin* of the Industrial Commission of Wisconsin, *Workmen's Compensation Insurance*, August, 1916, Tables VI and VII). A pay-roll of $50,000 per annum would correspond to something less than 100 full-time workmen.

1. One obvious method of combining classifications is to throw together those risk classes which have produced approximately the same pure premiums. This method is actually applied in the sense that the number of rate gradations is very much less than the number of risk classes. But these rate groups, or grades, are used only for the calculation of rates after the pure premiums have been established; they cannot appropriately be used for the determination of pure premiums because they represent only a fortuitous similarity of accident cost in a limited exposure. Furniture manufacturing, brass founding, machinery building, and interior painting and paperhanging may all have developed the same accident cost per unit of exposure,[1] but the component hazards of these industries are so diverse that continued similarity of pure premiums cannot be predicated. On the other hand, the processes and equipment employed in the manufacture of bedsteads, bookcases, chairs, desks, tables, incubators, and refrigerators, are so nearly identical that any divergence of pure premiums in a limited exposure may properly be disregarded, and the rate for each be derived from the combined experience of the group. On this principle the 1,500 manual classifications have been arranged in some 300 groups of industries or businesses which are presumed to be similar in kind and degree of hazard.[2] Unfortunately, however, the subject has not received sufficient study from either the statistical or the engineering standpoint. Many of the existing groups are wanting in homogeneity, while others are separated by arbitrary lines of nomenclature. Hence, the risk groups actually used in rate-making do not strictly conform to the statistical groups nor are

[1] The actual "basic" pure premiums on all these classifications, by the last available experience, is about $0.47 per $100 of pay-roll.

[2] The present industry groups were developed by the statistical committees of the International Association of Industrial Accident Boards and Commissions, and of the National Workmen's Compensation Service Bureau—a voluntary association of some twenty stock casualty insurance companies.

The number of effective rate groups is not easily determinable, but is less than the number of code groups. Thus, engine manufacturing ranks as a separate group, though the rates for each member of the group are in fact derived from the machine-shop and foundry experience. There are numerous similar cases, some of them relics of former rate discriminations, others due to sheer want of courage and insight on the part of code compilers.

they consistently preserved in successive revisions of the manual. So far are the present industry groups from definitive recognition that it is always a matter of judgment, and often a matter of controversy, at each rate revision, whether the rate for a particular classification should be based upon the specific experience of the class or the combined experience of the group to which it is assigned, or related to the experience of some specific risk class which is deemed to be analagous in hazard. Nevertheless, the use of group experience has narrowed the field of sheer "underwriter's judgment" in rate-making and has removed many former discriminations in particular class rates. A further and great advance would result from a thorough recasting of the present groups upon the basis of systematic engineering and statistical inquiry.

2. The combining of experience from different states would present no great difficulty if only the scale of benefits were uniform or susceptible of uniform grading from a common basis. No doubt the hazards of particular industries, such as coal mining, logging, agriculture, machinery building, or cotton spinning, vary somewhat widely in different geographical regions. Yet such differences, after all, are not perhaps very numerous nor very difficult of determination. It is the immense diversity of benefits for similar injuries which goes furthest to vitiate any comparison of pure premiums produced under different jurisdictions. The percentage of wages payable to injured or dependent beneficiaries, the minimum and maximum weekly benefits, the "waiting period," the rate and duration of payments for death and permanent disability, the amount of medical aid—all differ widely and erratically from state to state, so that no single ratio will hold for all classes of benefits as between any two jurisdictions.

Notwithstanding the obvious objections just recited, rate-making committees have heretofore relied upon single ratios, in the form of flat "law differentials," for the purpose of reducing to a common denominator the pure premiums incurred under dissimilar benefits. The law differential, in this sense, is the ratio between the (computed) ultimate cost of compensation for 100,000 accidents in a hypothetical standard distribution under the given scale of benefits and the (computed) ultimate cost of the same accidents

under the Massachusetts Act of 1912. The standard distribution employed was worked out by Dr. I. M. Rubinow on the basis of European and early American statistics[1] and shows the number of injuries of each specified degree of severity normally to be expected in 100,000 accidents causing disability for at least one day. The computation based upon this table is modified by a more or less conjectural allowance for medical aid and for the effect of minimum and maximum wage limits.[2] The most that can be said for this method is that no better basis has yet been devised for estimating the relative cost of compensation laws *in advance of experience*. As applied to the *experienced* pure premiums of specific classifications, however, the method is open to very grave objections.

A flat law differential, in truth, rests upon an assumption which is clearly contrary to fact—the assumption, namely, that the distribution of severity of work injuries is the same for all industries. If the proportion of deaths and permanent disabilities and the average duration of temporary disabilities were indeed the same in coal mining as in silk weaving, the detailed differences above spoken of might safely be ignored for the purpose in hand. Unfortunately for the hypothesis, the facts are notoriously otherwise. Ten thousand accidents do not cost the same in the sewing trades as in railroad transportation, nor will the average ratio between the New York and the original Massachusetts scale of benefits hold for either stone quarries or retail stores. By ignoring these differences, the flat differentials distort experience both in the process of reducing experienced pure premiums to the basic level and in the subsequent application of state multipliers to the basic pure premiums so derived.[3]

[1] Rubinow, *Standard Accident Table*.

[2] The present practice is to express medical benefits as a percentage of the computed cost of other benefits. Independent computation, upon the basis of medical benefit statistics classified by severity of injury, would at least avoid cumulative error.

As to the effect of wage limits, the wage-distribution statistics relied upon for most states are woefully inadequate.

[3] The actual process of deriving basic pure premiums consists in adding together the reported pay-rolls and "reduced losses" of all states and dividing the combined "reduced losses" by the combined pay-rolls. The "reduced losses" are obtained by applying to the reported losses of the given state a "reduction multiplier" which is the reciprocal of the law differential. The pure premium for a given state is then

The weakness of the flat law differentials is well understood by compensation statisticians and actuaries, and the corrective is neither recondite nor impracticable. It consists merely in the analysis of accident costs by severity of injury and the application of an appropriate differential to each injury group—deaths, permanent total disabilities, permanent partial disabilities, temporary disabilities. The one obstacle to the use of this simple and obvious method is that neither insurance carriers nor state administrators have compiled accident statistics in a form appropriate to the purpose. Meanwhile the rates for the leading classifications in important states are derived from the separate experience of the state in question; in other states and for other classifications the basic pure premiums, with all their admitted imperfections, are necessarily employed.

The combined effect of prospective rates, full reserve premiums, over-refined risk classes, and flat state differentials, is to introduce a large measure of conjecture into the most fundamental of all rate-making data—the actual cost of insured benefits per unit of exposure. The basic pure premiums do not truly represent the reported experience and scarcely deserve the reliance actually placed upon them by rate-making committees. What is scarcely less serious, the reported experience itself, even if correctly translated, is not a sufficient basis for prospective insurance rates, because (*a*) the exposure on many risk classes is wholly inadequate, (*b*) the outstanding liabilities may not have been correctly

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obtained by multiplying the basic pure premium by the law differential. Thus the aggregate pay-roll for the classification "machine shops, no foundry," as last reported, was $78,254,573, and the aggregate "reduced losses" $364,666, producing a basic pure premium of $0.466. The Pennsylvania pure premium for 1917 is 1.20×.466 or $0.559.

The distortion spoken of in the text is most serious in the case of New York experience which is at once the largest in volume and the least susceptible of reduction by a flat divisor. Thus, with the reduction factor employed at the last rate revision, losses of $18,900 from New York would count for $10,000 reduced losses, irrespective of the actual components. But if this sum comprised $12,000 for one permanent total disability and $6,000 for one death, the true basic equivalent would be much nearer $5,000 than $10,000. Conversely, the flat differential gives much too small a value for New York when applied to a basic pure premium which comprises a large proportion of death and permanent total-disability losses.

estimated, (*c*) the reported experience may not have covered the precise range of business which the risk class is intended to describe,[1] and (*d*) the experience relied on may relate to a period of greater or less industrial activity, or of more or less effective accident prevention than that for which the rates are projected. Hence, in the actual process of rate-making, the calculated basic pure premiums are more or less modified by judgment, and a number of more or less conjectural loadings are introduced into the state multipliers.

Judgment is necessarily exercised in the grouping of minor classifications to obtain a combined experience or in the gradation of risk classes within a group or in the assignment of a rate for one classification by analogy to some other for which a large volume of experience has been reported. The indicated pure premiums, again, unless the recorded exposure is very large, are frequently graded up or down on the ground that the reported losses include less or more than the expected proportion of death and permanent disability benefits.[2] It results from these judgment modifications that the "selected" pure premiums for many classifications depart rather widely from the experience indication. In the aggregate, indeed, the pure premiums selected at the last rate revision exceed the calculated reduced losses by some 9 per cent.[3] This judgment

[1] In the last rate revision, for example, the reported experience for coal merchants, fuel and material dealers, stevedores, sawmills and planing-mills, was had under classifications covering a different range of operations from the classifications now in use. About $8,000,000 of pay-roll from Illinois was thrown out of the Masonry N.O.C. classification on somewhat similar grounds.

[2] The average proportion of death benefits to all benefits, upon the total extant experience from New York, Massachusetts, New Jersey, Illinois, Michigan, Wisconsin, Minnesota, Iowa and California, is approximately 20 per cent. This ratio was often referred to by the Augmented Standing Committee, 1917, as a basis for judgment modifications of indicated pure premiums. Such a norm is doubtless a better guide than unrestrained judgment, but it tends to an artificial leveling up of pure premiums. The varying proportion of serious injuries is precisely one of those hazard differences between industries which accident insurance rates are intended to reflect.

Mr. E. E. Watson, actuary of the (monopolistic) Ohio State Fund, has devised a more systematic, consistent, and equitable method of "spreading" death and permanent total disability losses by charging a fixed proportion of each such loss to the specific risk class in which it originated and distributing the remainder over the broad industry group which includes this classification.

[3] Writer's calculation.

loading is by no means uniformly distributed, but falls mainly upon high-rated industries and minor classifications.

The basic pure premiums, finally, whether selected or calculated, are translated into state pure premiums by means of multipliers which rest as much upon judgment as upon ascertained fact. (*a*) The least disputable of the factors entering into these multipliers are the state law differentials whose weaknesses were adverted to in another connection. (*b*) The law differentials themselves are graded in accordance with the age of the act in question, upon the theory that the cost of compensation progressively increases during the first few years' experience as accident reporting improves and workmen become better educated to their legal rights.[1] (*c*) In the last rate revision, moreover, account was taken of the fact that the experienced pure premiums were derived from several years of normal or even subnormal industrial activity, whereas rates were to be projected for a period of unparalleled expansion. It was commonly believed that the excessive loss ratios indicated by immature experience for 1916 were somehow correlated with this sudden expansion of industry. There was no conclusive evidence of such correlation, much less any quantitative measure of increased accident cost per unit of pay-roll, but the prevailing belief was borne out by certain partial tests and by the common knowledge that the speeding up of industry means more crowded plants, more driving of workmen, more overtime, a greater number of inexperienced employees, and less attention to accident prevention. On this somewhat dubious basis, then, a loading of 15 per cent was incorporated in the basic pure premiums to offset the supposed effect of increased industrial activity. (*d*) Logically antedating all the foregoing factors is an allowance of 2 per cent in the basic pure premiums themselves for underestimate of outstandings in the

[1] The Actuarial Sub-Committee of the Augmented Standing Committee, 1917, upon the basis of a fair volume of experience from California, Massachusetts, Rhode Island and Wisconsin, determined the ratios to be: first year, 1.00; second year, 1.10; third year, 1.15; fourth year, 1.18; fifth year, 1.20. Inasmuch as the pure premium experience relied on, being derived from policy years of issue 1912, 1913, and 1914, answered nearly to the mean of the first and second years, upon a weighted average, these ratios were taken at: first year, .95; second year, 1.05; third year, 1.10; fourth year, 1.125; fifth year, 1.14.

reported losses. It is doubtful whether any allowance under this head is justifiable in face of the substantial judgment loading already referred to; in any case, the percentage fixed upon implies a degree of accuracy in the determination of pure premiums which has not been, and is not likely to be, realized.

By bringing all these factors together, the pure premium for the state of New York, for example, becomes

$$p=(1.02\pi\times 1.89)(1+.125+.15)=2.4579\pi \ *$$

where π is the basic and p the state pure premium (or expected accident cost), 1.02 the factor for underestimate of outstandings, 1.89 the state law differential, 1.125 the factor for claim cost in the fourth,[1] as compared with the first year of compensation, and .15 the estimated increase of claim cost for current, as compared with a period of normal industrial conditions. In such a formula experienced losses have ceased to be the main element of even the expected pure cost of benefits insured. The basic pure premiums serve chiefly as a guide to *relative* rates; absolute rates are derived in greater part from factors which professedly are not susceptible of mathematical determination.[2]

II. EXPENSE AND PROFITS LOADING

To the pure premium (or expected cost of benefits insured) must be added the expenses and profits of insurance carriers to make up the full sum of insurance cost. Management expenses

* All rates were in addition "loaded" by 1 per cent to offset reductions by experience rating, and rates for classifications subject to schedule rating were increased by a further 9 per cent to offset schedule-rating credits—a curious commentary upon the accident prevention value of merit rating as privately viewed by insurance carriers. The experience-rating factor was incorporated in the state multiplier, but the increase for schedule rating was concealed in the rate symbols. Apparently it was not deemed wise to inform employers that their "merit discounts" are fictitious.

Both these loadings were rejected in Pennsylvania on the ground that the merit-rating system there used produces an approximate balance of charges and credits.

[1] The fourth year of compensation in New York ends July 1, 1918.

[2] Both the basic pure premiums and the derived rates are, notwithstanding, arranged in a hypothetical expotential series, starting with one-cent intervals. The result is to give a fictitious accuracy to rates of which the error may often be as much as 25 per cent. It must be a very innocent layman who is deceived by the meretriciously mathematical rate of $3.03.

vary from state to state, from industry to industry, and from one type of carrier to another, but the average for stock companies throughout the United States is about 40 per cent of gross compensation premiums, distributed as follows:[1]

	Percentage
Acquisition of business (chiefly agents' commissions)...	17.5
Adjustment of claims (investigation of claims, defense of suits, handling of vouchers, etc.).....	7.0
Inspection of risks.....	4.0
Pay-roll audits.....	2.0
General administration[2] (home office).....	7.0
Taxes and fees.....	2.5
	40.0

At the last rate revision a further loading of $1\frac{1}{2}$ per cent upon gross premium was introduced for underwriter's profit, corresponding to about 5 per cent upon the capital at risk.[3] This allowance appears at first sight very moderate, but when it is remembered that the capital is itself invested in income-bearing securities, that the insurer enjoys a constant return upon unearned premiums[4] nearly or quite equal to the capital invested, and that reserves very commonly are computed at final, instead of present, values,[5] the necessity for any profits loading, *eo nomine*, is by no means obvious. If pure premiums were closely calculated and reserves set up on true present values, the rates might properly carry a margin for

[1] See *Proceedings of the Joint Conference on Workmen's Compensation Insurance Rates*, 1915 (New York Insurance Department), and the (unpublished) Minutes of the Actuarial Sub-Committee of the Augmented Standing Committee, 1917.

[2] Later data appear to indicate that the cost of pay-roll audits is rather less, and general administration rather more, than the foregoing table indicates. The latest returns give about 10 per cent for general administration, including pay-roll audits. But this item, under present accounting methods, is pro-rated upon premium income so that it is impossible to determine whether the proportion properly chargeable to compensation is less or more than for other lines of insurance carried by the same company.

[3] Minutes of Actuarial Sub-Committee, U.S.

[4] Compensation premiums commonly are paid in advance so that about one-half of the premiums in force at any given time are unearned.

[5] Taking all sources together, the largest casualty company in the United States, during 1916, had an investment income of $950,000, or about 15 per cent upon the paid-up capital of $6,000,000. This experience is fairly typical and goes to show that investments will in general afford a sufficient return upon capital at risk.

underwriting profit. Under present conditions, however, such a loading is justifiable only as a precaution against deficiency in projected pure premiums.

Heretofore the expense and profits loading has been incorporated as a uniform percentage of gross rate, in accordance with the formula

$$R=\frac{p}{1-L}, \tag{1}$$

where R is the total rate, p the state pure premium, and L the loading for management expenses and underwriting profit. Taking L at the average value .415, $R=1.709p$, or $p=.585R$, which being interpreted means that 58.5 cents out of each dollar of compensation insurance premiums are devoted to the payment of compensation benefits. Obviously, however, management expenses do not in fact bear this constant proportion to gross rates. It costs no more to issue a policy for $1,000 annual premium than a policy for $10; in either case, the same forms must be filled out and the same number of entries made upon the insurer's books. The inspection cost, again, is scarcely higher for an iron foundry than for a clothing factory with the same number of employees, though the premium is perhaps ten times as great. Adjustment expenses, also, are smaller in proportion to premiums for the high-rated than for the low-rated classifications and for the high-benefit than the low-benefit states. The cost of handling accident reports, of mailing out voucher checks, of investigating claims and presenting cases for adjudication, is very nearly the same irrespective of the scale of benefits and is higher proportionately for trivial than for serious injuries. Management expenses, in short, vary with the number of risks, the volume of pay-roll and the number and character of accidents corresponding to a given premium income, in such wise that the ratio of total expenses to benefits insured falls as the premium income per risk or per $100 of pay-roll increases. A uniform expense loading, consequently, works injustice to large employers, high-rated industries, and high-benefit jurisdictions. Under existing practice, an employer whose rate is already high because of the inherent hazard of his

business is further mulcted in overhead charges for the benefit of employers whose total rates would in any case be low.

The inequity of a uniform expense loading was recognized so long ago as 1915 by the Actuarial Committee of the Joint Conference on Workmen's Compensation Insurance Rates.[1] At that time the principle was established that total loadings should vary inversely with the scale of benefits, and a graded scale was adopted ranging from 35 per cent of gross rates in the highest to 42.5 per cent in the lowest-benefit jurisdictions. It is obvious, however, that this principle must be carried further if management expenses are to be equitably distributed as between risk classes in the same jurisdiction. The first step in such a distribution is to relate the functional components of management expenses[2] to their respective bases of incurrence.[3] (1) Commissions and taxes are incurred as a percentage of gross premium and vary directly therewith. Profits, likewise, may fairly be reckoned as a uniform loading upon gross rates. (2) Adjustment costs are more nearly a function of pure premium than of total rate though partly proportionate to the number as well as to the cost of accidents. (3) The cost of inspection and of pay-roll audits is proportionate to pay-roll and number of risks. (4) Home office (general administrative) expenses are properly chargeable in part to number of risks (policy accounts), in part to pure premium (agency and underwriting supervision, investment of reserves, executive salaries, rents, and office expenses not otherwise allocated, and a portion of the statistical cost), and in part to pay-roll insured (accident reports and statistics). In accordance with this analysis the expense and profits loading should logically comprise four factors: (1) a constant percentage of gross premium, (2) a constant percentage of pure premium, (3) a constant addition per $100 of pay-roll, and (4) a fixed charge per policy. The last-mentioned factor may for the present safely be ignored; the excess cost of insuring small risks is more than covered by the existing scale of minimum

[1] *Proceedings*, U.S., pp. 24–26. [2] See p. 976.

[3] Cf. a very able paper by Mr. J. H. Woodward, on "Provision for Expenses in Workmen's Compensation Premiums," *Proceedings of the Casualty Actuarial and Statistical Society of America* for April, 1917.

premiums.[1] The main object of a graded expenses loading—greater equity as between risk classes—will be sufficiently attained by resolving expenses and profits into three factors.

If, then, a be allowed to represent a percentage of gross rate, e a percentage of pure premium, and K a constant addition per \$100 of pay-roll, the rate formula (1) $R=\frac{p}{1-L}$ * becomes

$$R=\frac{p(1+e)+K}{1-a}. \dagger \qquad (2)$$

The values assignable to these factors cannot, in the present state of casualty insurance accounting, be determined with perfect certainty. The expenses proportionate to gross rate a are, indeed, a known quantity; the proper weights of the remaining factors are, to some extent, a matter of inference. The distribution in Table I follows very closely that suggested by a very able compensation actuary, Mr. J. H. Woodward.[2] Fortunately the

TABLE I

ALLOCATION OF LOADINGS IN PERCENTAGES OF GROSS PREMIUMS

Functional Division of Expenses	Total	Proportional to Gross Premiums	Proportional to Pure Premium	Proportional to Pay-Roll
1. All expenses and profits..	41.5	21.5	12.0	8.0
2. Acquisition.....	17.5	17.5	0.0	0.0
3. Pay-roll audits.....	2.0	0.0	0.0	2.0
4. Home office.....	7.0	0.0	5.0	2.0
5. Inspection.....	4.0	0.0	2.0	2.0
6. Claim adjustment.....	7.0	0.0	5.0	2.0
7. Taxes.....	2.5	2.5	0.0	0.0
8. Profits	1.5	1.5	0.0	0.0

[1] A minimum premium is the smallest amount for which a risk in a given classification will be insured for one year, irrespective of pay-roll. The present minima range from \$10 to \$250 for risks of different classes. Mr. Woodward, *loc. cit.*, very cogently argues that the minimum premium is a less equitable method of allocating management expenses than the policy fee.

* See p. 976.

† The formulae below are taken from Mr. Woodward's paper, *loc. cit.*, with slight changes of notation. Unfortunately a standard notation for compensation insurance does not exist.

[2] *Loc. cit.* The table in the text differs from Mr. Woodward's Table A only in respect to claim adjustment.

proposed method of loading is such that errors in the item weights are partially compensating.[1]

On the basis of the foregoing distribution in formula (2)

$$R=\frac{p(1+e)+K}{1-a},\ a=.215,\ e=.12R,\text{ and } K=.08R.$$

Since, however, the total expense and profits loading is $.415R$, $p=.585R$ and $e=.205p$. The value of K will depend upon the average premium rates to be collected. From the experience reported to the Augmented Standing Committee, 1917, it appears that the average manual rate (excluding clerical office) upon policy issues of 1912, 1913, and 1914 for the entire country was approximately \$0.80 per \$100 of pay-roll.[2] The new rates are probably 25 per cent higher upon an average, or say \$1.00, which would give a value of \$0.08 for K. Substituting, the formula above becomes:

$$R=\frac{1.205p+\$0.08}{.785} \tag{3}$$

or $1.54p+\$0.10$ (round numbers).

The effect of this formula, as compared with a uniform expense loading, is exhibited in Table II. It will be seen that the proposed loading is graduated from 60 per cent of gross rates upon a pure premium of \$0.10 to 36 per cent upon pure premiums of \$3.00 and upward. The lowest rates, consequently, are sharply increased, while the high rates are decreased by 7 or 8 per cent, and the medium rates (pure premiums, \$0.40 to \$1.00) are but little affected. Of course no particular merit can be claimed for the precise loadings employed in the foregoing illustrations: the proportionate expenses chargeable to pure premium and to pay-roll respectively (values of e and K in the formula) were confessedly derived by judgment and might be considerably varied without greatly affecting the purpose sought. It is earnestly contended, however, that some such scheme of graded loadings

[1] Any decrease in the value of e (formula 2) is partly offset by a compensating increase in the value of K. Thus the values in the text give a rate of \$0.25 for a pure premium of \$0.10 and of \$1.64 for a pure premium of \$1.00, whereas Mr. Woodward's values would produce rates of \$0.24 and \$1.66, respectively.

[2] Obtained by dividing aggregate pay-rolls into aggregate reduced losses and loading the resultant average pure premium by 66⅔ per cent for expenses.

would conduce to greater equity in the distribution of insurance burdens. This point, indeed, is now conceded by perhaps a majority of compensation actuaries.[1] Underwriters are still disposed to look askance upon so radical a departure from immemorial practice. The principle, however, has been adopted in Pennsylvania and is likely to receive early and serious consideration elsewhere.

TABLE II

COMPARISON OF RATES PRODUCED BY GRADED AND UNIFORM EXPENSE LOADINGS

Pure Premium	Rate with Graded Loading	Rate with Flat Loading	Percentage of Graded Loading to Gross Rate
$0.10.....	$0.25	$0.17	60.0
0.20.....	0.41	0.34	51.0
0.30.....	0.56	0.51	46.0
0.40.....	0.72	0.68	44.0
0.50.....	0.87	0.85	42.5
0.60.....	1.02	1.03	41.0
0.75.....	1.26	1.28	40.5
1.00.....	1.64	1.71	39.0
1.50.....	2.41	2.56	38.0
2.00.....	3.18	3.42	37.0
2.50.....	3.95	4.27	36.7
3.00.....	4.72	5.13	36.5
3.50.....	5.49	5.99	36.0
4.00.....	6.26	6.84	36.0
5.00.....	7.80	8.55	36.0

III. CATASTROPHE LOADING

Catastrophe cost is, in strictness, a part of pure premium. Very few risk classes, however, furnish a sufficient volume of exposure to determine the cost of occasional disastrous accidents.[2] It appears most equitable, therefore, to spread the cost of such disasters over industry as a whole. Data in hand indicate that one cent per $100 of pay-roll (two cents in New York State) will cover the compensation benefits for all accidents which cause five or more

[1] See *Report of the Actuarial Sub-Committee of the Augmented Standing Committee*, 1917, p. 14. The adoption of a graded expense loading was urged by the writer, and by Messrs. Woodward, Mowbray, and Black. The Committee, by formal resolution, approved the plan in principle, but declined immediate adoption on the ground of insufficient time to work out the details.

[2] Coal mining is a notable exception. The explosives industry would perhaps fall in the same category if only it were brought within the pale of insurance experience.

deaths at one time.[1] The present practice is to treat this amount, not as a constant addition to pure premium, but as a constant addition to gross rate. In this form, however, the catastrophe loading is subject to deduction for commissions, taxes, profits, and ultimate adjustment expense (for catastrophe accidents) which leaves a net value of some seven mills available for catastrophic losses. The precise calculated value would be obtained by adding one cent to K in the graded loading formula (2) hereinbefore proposed.[2] The point is curious rather than important.

IV. ORGANIZATION FOR RATE-MAKING

The foregoing recital should suffice to show that compensation insurance rates are still very far from "scientific." The data are by no means so definite, nor the principles so well established, that rate-making can be relegated to a group of disinterested experts. There is no collection of pure premium statistics in any way comparable to the standard mortality tables of life insurance. For a few states the classified experience of all insurers is officially reported and published; elsewhere experience is recorded only in the private files of insurance carriers. Neither is there any large body of established principles: the most fundamental statistical and actuarial problems are yet in an early stage of discussion.[3] Underwriters' judgment, accordingly, plays a great, often a decisive, rôle in the determination of rates, and the exercise of this judgment gives scope to the play of competitive interests. But the less determinate the ultimate cost of any commodity is the greater the danger of ruinous losses from competitive price-cutting—a lesson enforced in compensation insurance by bitter experience. Hence the felt necessity of organizations for assembling statistical experience, establishing rate-making procedure, and harmonizing opposed views to the end that rates may be reasonably stable, adequate, and equitable. Out of these considerations, backed in several states by official rate supervision, has grown a somewhat loose, but fairly effective, organization for rate-making.

[1] See *Proceedings of Joint Conference*, 1915, U.S.

[2] See p. 978.

[3] Cf. the Casualty Actuarial and Statistical Society of America.

The rate-making machinery as thus far developed comprises a series of rating bureaus, or associations of insurers, official and unofficial,[1] several insurance departments or other supervisory authorities and a number of joint committees representing both bureaus and departments. Of the last-mentioned bodies the most important are the Standing Committee on Manual Rates[2] and the Standing Committee on Schedule Rating, each composed of three stock companies, two mutuals, a (competing) state fund, and an insurance department. Through these committees are cleared all revisions of rates or schedule rating, whether general in character or pertaining only to particular risk classes. The committees have no official status, their decisions are not binding upon either the constituent bureaus or any supervising authority, and the insurance department, which by courtesy acts as chairman, has only a casting vote without veto. The greatest weakness of the existing organization, indeed, is that rates are necessarily made for separate jurisdictions and subject to separate state supervision so that common action depends upon a very general consensus of opinion. Inasmuch as both the balance of insuring interests and the views and policies of administrative authorities differ from state to state, uniformity of practice is very difficult to maintain. Nevertheless, the recommendations of the Standing Committees carry great weight on account of their balanced composition[3]

[1] The affiliated bureaus are (1) the National Workmen's Compensation Service Bureau and (2) the official rate-making and enforcing bureaus of New York, Massachusetts, Pennsylvania, and California.

[2] The Standing Committee on Manual Rates grew out of a Joint Conference on Workmen's Compensation Insurance Rates (cited above as Joint Conference) held in the fall of 1915 and participated in by the National Service Bureau, the Compensation Inspection Rating Board (of New York), the Massachusetts Bureau, the Insurance Departments of New York, Massachusetts, and Pennsylvania, and the Industrial Commission of Wisconsin. For the general rate revision of 1917 the permanent committee was temporarily enlarged by the addition of two stock and two mutual companies. This temporary body is known as the Augmented Standing Committee, 1917.

[3] Excessive rates, wherever rates are uniform for all carriers, operate to the competitive advantage of participating carriers by increasing the margin for policy dividends. Conversely, large stock companies not infrequently have championed unremunerative rates in order to embarrass competitors. Besides this historic alignment of stock and mutual carriers, there are many cross-combinations and divisions upon particular classifications, determined by the competitive interests of particular companies represented upon rate-making committees.

as well as of the individual ability and experience of their members. Largely through their influence substantial uniformity throughout the United States has been established in classifications, in schedule rating, and in *relative* rates for the several risk classes.[1]

Neither the present methods of rate-making nor the existing machinery for that purpose, neither the data employed nor the results produced, are wholly satisfactory to insurers or insured. Yet, to anyone acquainted with the rate-making situation in employers' liability days, or even with current practice in other branches of casualty insurance, the progress achieved during five years of compensation experience is full of encouragement. Doubtless, rates will never be so stable or so much a matter of mathematics as in life insurance. The great variety of conditions to be met and the incontinent changes to which those conditions are subject, will always call for underwriting judgment as well as actuarial competition. But as the mass of statistical experience grows and is subjected to more searching analysis, ascertained fact will more and more narrow the field of judgment. In particular, the pure premium values of divergent legal benefits and the pure premium effects of local variations in occupational hazards or of cyclic fluctuations in industrial activity, are all susceptible of statistical determination. It is fairly to be expected, also, that further development of public-rate supervision, which seems now in full course, will lead to a more authoritative and coherent organization for rate-making. Another decade, accordingly, should put compensation insurance rates upon a sound and stable basis, so far as such a consummation can be hoped for under competitive conditions.

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[1] The "basic manual," in general use, expresses the rates for all states by a uniform set of symbols, with separate key sheets for each state.